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(54) TWO-STAGE REFRIGERATION GAS MACHINE

The invention pertains to refrigeration gas machines and can find use in cryogenic engineering.

Two-stage refrigeration gas machines are known that operate according to the reverse Stirling cycle, the stages of which are connected by a heat tube to evaporation, condensation and transport zones.

Drawbacks of the known installations include significant thermal resistances, which develop between the corresponding zones of the heat tube and the stages of the refrigeration gas machine, since heat transfer between the condensation zone of the heat tube and the first stage of the refrigeration gas machine is accomplished because of the heat conductivity of parts of its surface.

Thus, the temperature drops between the first and second stage can be significant. The refrigeration capacity then sharply drops and the power consumed in the first stage sharply increases.

The objective of the invention is to increase refrigeration capacity of the machine. This is achieved in that the evaporation and condensation zones are designed in the form of hollow cylinders with axes perpendicular to the axis of the transport zone and with tubular elements positioned within the cylinders, connected to the gas lines of the corresponding stages; parts of

the outer surface of the tubular elements and the inside surface of the cylinder of the evaporator zone are covered with porous inserts connected by connectors made of porous material.

Figure 1 schematically depicts a refrigeration gas machine in longitudinal cross-section; Figure 2 shows a heat tube in longitudinal cross-section.

The refrigeration gas machine consists of two stages and of an intermediate heat exchanger in the form of heat tube 1.

The first stage contains a compressor cavity 2, cooler 3, regenerator 4, connected to the condensation zone 5 of the heat tube, and also expansion cavity 6. The second stage contains cooler 7, the heated part 8 of the regenerator and the cold part 9 of the regenerator. An evaporation zone 10 of the heat tube with porous insert 11 is incorporated between them. The evaporation and condensation zones of the heat tube 1 are connected by the transport zone 12 and the cold part of the regenerator is connected to heat exchanger 13.

For passage of gas from the compressor cavity 2 into the expansion cavity 6 of the first stage in the condensation zone 5, finned tubes 14 are incorporated. In the second stage for passage of gas from cooler 7 to heat exchanger 13 in the evaporation zone, finned tubes 15 are also incorporated. When the stages of the refrigeration gas machine are positioned horizontally in the vertical plane and the condensation zone is positioned above the evaporation zone, the internal surface of the condensation and transport zones are made with unreinforced porous material. This permits a reduction in hydraulic resistance in terms of liquid.

In the first stage, the gas compressed in the compressor cavity 2 goes to cooler 3, where it gives up its heat. The gas then passes through regenerator 4, is cooled there by the cold accumulated in it during the previous cycle and goes through tubes 14 of the condensation zone 5 into the expansion cavity 6, where it expands. During expansion, the gas temperature diminishes and it is forced in the opposite direction into compressor cavity 2. During reverse flow, part of the cold is consumed by the condensation zone of heat tube 1 and condenses its heat transfer agent on tubes 15.

The work of the second stage occurs similarly, with the difference that during direct flow of gas, part of the heat is consumed for evaporation of the heat transfer agent on the surface of tubes 15 of the evaporation zone. The vapors of the heat transfer agent rise upward and pass through transport zone 12 into the condensation zone, where, as already discussed above, they are condensed on tubes 14. The condensate goes by gravity along the walls of the transport zone 12 to the porous insert 11, with which it is uniformly distributed on the surface of tubes 15. The process then repeats.

Claims

1. Two-stage refrigeration gas machine operating according to a reverse Stirling cycle, the stages of which are connected by a heat tube to the evaporation, condensation and transport zones, characterized by the fact that, in order to increase refrigeration capacity, the evaporator and condensation zones are designed in the form of hollow cylinders with axes

perpendicular to the axis of the transport zone, and with tubular elements positioned within the cylinders, connected to the gas paths of the corresponding stages.

2. Machine according to Claim 1, characterized by the fact that parts of the outside surface of the tubular elements and the inside surface of the cylinder of the evaporation zone are covered with porous inserts connected by means of connectors made of porous material.

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